Reply to:

Anonymous Referee #2

Referee comments in black, author replies in blue

Overall Comment and Recommendation: This manuscript presents 14 months of near-continuous, real-time measurements of non-refractory submicron aerosol (NR-PM1) by using a time-of-flight aerosol chemical speciation monitor (ToF-ACSM) at the Jungfraujoch mountain site in Switzerland. This is an important study as it provides in depth insights into the sources of organic aerosol as well as seasonal trends at a high elevation site in Europe. Long-term mass and chemical measurements of NR-PM1 are starting to really take off around the world, including sites in Europe, the United States, and southeast Asia. This is an exciting time and this study certainly adds to this growing body of data that will likely be useful to the modeling community that estimate impacts of PM on air quality and climate. The authors find that NR-PM1 concentrations peak in summer due to increased planetary boundary layer (PBL) air influences and lower concentrations in winter. The largest fraction is from organic compounds and in transient months sulfate can be rather high at this site. Interestingly, from backward air trajectory analyses, the authors find that sulfate is elevated from the south but organics are dominant from all cardinal directions. The major source of organic aerosol at this site is low-volatility oxidized organic aerosol (LV-OOA), where LV-OOA 1 is assigned to a background type and LV-OOA 2 is assigned to vertically transported type mostly seen in summer. BBOA was only seen during a rare regional event in summer 2013 and during winter. The authors will likely be interested in papers coming from the Surratt Group at the Look Rock, Tennessee USA mountain site using the quadrupole ACSM. One of these papers was just published in ACP (Budisulistiorini et al., 2015) and the other one that presents yearlong data will appear soon in ACPD (Budisulistiorini et al., 2015). It seems many of the findings, such as aged OOA and some infrequent BBOA events, are shared by both mountain sites. Overall, the data presented in this study will be of interest to the atmospheric chemistry community and should be published in ACP.

However, I kindly ask that the authors address the specific and minor comments below before publication.

Specific and Minor Comments:

1.) Page 18227, Line 11: delete ".e.g.," as this is not necessary.

Revised.

2.) Page 18227, Line 14: insert hyphen between "high" and "time"

No change was made because several native English speakers were asked and all of them preferred either “high time resolution” or “high time-resolution”

3.) Page 18227, Line 19: delete "of"

Revised.

4.) Page 18227, Line 19: insert "of sampling" after the word "weeks"

Revised.

5.) Page 18227-18228: The authors may want to include in their citation here for 1 year studies a 1 year study in both Atlanta, GA, USA and Look Rock, TN, USA by Budisulistiorini et al., 2015 (ACPD). This paper is in press for ACPD. Here are the details - S. H. Budisulistiorini, K. Baumann, E. S. Edgerton, S. T. Bairai, S. Mueller, S. L. Shaw, E. M. Knipping, Avram Gold and J. D. Surratt (2015). Seasonal Characterization of Submicron Aerosol Chemical Composition and Organic Aerosol Sources in the Southeastern United States: Atlanta, Georgia and Look Rock, Tennessee. Atmos. Chem. Phys. Discuss., in press.

The suggested reference was added to the list.

6.) Page 18228, Line 18: Change "gasphase" to "gas-phase"

Revised.

7.) Page 18229, Line 3: comma needed after "Furthermore"

Revised.

8.) Page 18230, Line 1: UTC or local time?

Local time. Revised.

9.) Experimental: The authors are confident a naifion dryer is not needed for sampling???

Yes, the always large temperature differences between outside and laboratory (usually >25°C) make additional drying superfluous. This is standard procedure at the JFJ site and is confirmed in long-standing measurements. The RH of the inlet line is continuously monitored (< 40% required by GAW) and always lies below 25%. An RH of 20% corresponds to a dew point of 0°C at indoor temperatures of 25°C. Typical dew point values at the JFJ are below 0°C.

10.) Backward air trajectories: I ’m curious, how accurate are the backward trajectories if 10 days is used? Why not a shorter time scale? I would think the meteorology is highly dynamic at this site, so 10 days of backward trajectory analysis seems quite ambitious to me. The authors need to justify this selection.

This question is similar to the one asked by referee #3 and additional arguments are given there. We would like to point out again that we are not using a single trajectory model in our analysis but simulations of a Lagrangian particle dispersion model. The difference being that the latter simulates the transport of thousands of air parcels for a given release time and describes their movement with the mean flow, but also turbulent and convective transport. We are not sure what the referee refers to when saying that the “meteorology is highly dynamic”. Our model simulations are based on 3-hourly input fields and not on any steady state fields. Hence, the flow calculation accounts for as much variability as is possible. Selecting 10 days is somewhat arbitrary. However, it is based on the fact that the total accumulated source sensitivity does not increase strongly after this time scale anymore (e.g. Folini et al., 2008). Others have even used longer backward simulation times with the same model for similar transport categorisations (e.g. Hirdman et al., 2010).

11.) Page 18237, Line 4: You mean "Following sections?" Sounds like this came directly from a PhD thesis.

Revised.

12.) Page 18239, Line 4: Delete "also"

Revised.

13.) Aerosol Acidity: Based on recent studies from GA Tech groups (Hennigan et al., 2015, ACP; Guo et al., 2015, ACP), using neutralization degree is no longer a good proxy to estimate aerosol acidity. It is better to use thermodynamic models, such as ISOROPPIA, to do this using ACSM inorganic data and meteorological data as inputs. I would revise this.

A note of caution referencing to the two mentioned articles was added to the text ("Furthermore, it is noted that recent studies have shown that the molecular ratio, i.e. degree of neutralisation is not a good proxy for the determination of aerosol pH aside from giving a very rough information if an aerosol is alkaline or acidic (Hennigan et al., 2015; Guo et al., 2015).)

14.) Page 18242, Line 4: It is not clear to me what does "non-FT" mean. Is it concentrations during injection layer (IL) or else?

The acronym was clarified in the text.

15.) Page 18242, Line 17: Delete "suggesting that"

Revised.

References:

Hirdman, D., Sodemann, H., Eckhardt, S., Burkhart, J.F., Jefferson, A., Mefford, T., Quinn, P.K., Sharma, S., Ström, J. and Stohl, A.: Source identification of short-lived air pollutants in the Arctic using statistical analysis of measurement data and particle dispersion model output, Atmos. Chem. Phys., 10, 669-693, 2010.

Folini, D., Ubl, S. and Kaufmann, P.: Lagrangian particle dispersion modeling for the high Alpine site Jungfraujoch, J. Geophys. Res., 113, D18111, 2008.